

PATENT SPECIFICATION

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NO DRAWINGS.

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COMPLETE SPECIFICATION.

Stable Aqueous Cutting Fluid containing an Amine Salt of Boric Acid.

We, MASTER CHEMICAL CORPORATION, of 13 North Huron Street, Toledo, Lucas County, State of Ohio, United States of America, a Corporation organised and existing under the laws of the State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an aqueous cutting fluid that is superior to prior aqueous cutting fluids in stability and in other properties.

Aqueous cutting fluids are of great potential value because of their superior cooling action. However, an aqueous cutting fluid, in order to be satisfactory, must meet certain strict requirements.

One of the requirements that an aqueous cutting fluid must meet is that it must contain ingredients which, in relatively small concentrations, impart powerful lubricating properties to the aqueous composition. Such ingredients, like the other ingredients in an aqueous cutting fluid, must be effective in relatively small concentrations. The use of any such ingredients of an aqueous cutting fluid in a substantial concentration is not feasible because it would entail prohibitive expense and would seriously impair the cooling action of the fluid.

Another requirement that an aqueous cutting fluid must meet is that it must not contain any ingredient that precipitates upon mixing with hard water or during use of the cutting fluid.

A further requirement of an aqueous cutting fluid is that it must not contain any ingredient that may be irritating to the skin.

A still further requirement is that an aqueous cutting fluid must have corrosion inhibiting properties so that it does not cause rusting or corrosion of any of the common metals.

Still another requirement is that an aqueous cutting fluid must be bactericidal and fungicidal in character so that the growth of bacteria or fungi is prevented.

An aqueous cutting fluid is not commercially acceptable if it has an offensive odor. This is one reason why the fluid should not be capable of supporting the growth of bacteria or fungi, since such growth is usually accompanied by the development of an offensive odor as well as by formation of a precipitate.

An aqueous cutting fluid also should be substantially transparent so that it does not interfere with the visibility of the work, and should not foam excessively.

The aqueous cutting fluids heretofore known have not met the foregoing requirements satisfactorily.

The invention is a stable aqueous cutting fluid that comprises a salt of boric acid and an aliphatic amine having from 1 to 3 adiphatic radicals each of which contains from 1 to 4 carbon atoms, and having at least one hydroxy group attached to a carbon atom. An aqueous cutting fluid according to the invention gives excellent results in applications in which the pressure per unit of area is relatively low, such as

surface grinding operations in which a large surface is being ground or in which a number of pieces are being ground simultaneously. For heavy duty applications, in which the pressure per unit of area is relatively high, an aqueous cutting fluid embodying the the invention preferably contains, in addition to the reaction product of boric acid and the aliphatic amine, a reaction product of such an amine and an unsaturated fatty acid having from 18 to 22 carbon atoms in which any substituent consists of a single hydroxy group. The number of mols of combined fatty acid in the composition preferably is from $\frac{1}{2}$ to $\frac{2}{3}$, the number of mols of combined boric acid, but may be a smaller proportion, for example $\frac{1}{4}$ or $\frac{1}{8}$ the number of boric acid radicals.

It has been discovered that an aqueous cutting fluid according to the invention has excellent stability. Moreover, a cutting fluid according to the invention is an excellent corrosion inhibitor for cast iron and steel. It also inhibits the growth of bacteria and fungi, and is not irritating to the skin or otherwise harmful to the operator.

It has been found that the incorporation of a nonionic wetting agent in an aqueous cutting fluid according to the invention is highly advantageous in preventing separation of the ingredients of a concentrated solution, and in preserving the clarity of a dilute solution particularly when hard water is used.

Another ingredient that may be used very advantageously in a cutting fluid according to the invention is a gel-forming solvent of the class consisting of higher alcohols and ethers. One important advantage of such an ingredient is that it makes it possible to incorporate a silicon anti-foam agent.

BORIC ACID.

The boric acid used in preparing an aqueous cutting fluid of the invention may be obtained by using ordinary boric acid (i.e., orthoboric acid H_3BO_3) or any other boron compound that forms boric acid in aqueous solution, for example, metaboric acid or boric oxide. It is believed that the boric acid forms an addition product or salt with the amine in a cutting fluid of the invention.

The boric acid in a cutting fluid of the invention acts as a rust inhibitor. Furthermore, an addition product of boric acid and an amine is a syrupy liquid and does not precipitate out of the cutting fluid. In addition, boric acid, unlike phosphoric acid and other acids whose salts have been employed in cutting fluids, has bactericidal properties.

AMINE.

The aliphatic amines which can be used in the practice of the invention, each of which has from 1 to 3 aliphatic radicals, each containing from 1 to 4 carbon atoms, and has at least one hydroxy group attached to a carbon atom, include primary, secondary and tertiary alkylol amines such as mono-, di- or triethanolamine. These amines are water soluble and are free from offensive odor. The preferred amine for use in the practice of the invention is triethanolamine, which ordinarily comprises minor amounts of mono- or diethanolamine, and has no odor; its mildly alkaline properties aid in making the present cutting fluids extremely low in toxicity and absolutely safe against dermatitis; and, in combination with boric acid, it is an excellent rust inhibitor for cast iron and steel.

OTHER INGREDIENTS THAT MAY BE USED.

An unsaturated fatty acid, having from 18 to 22 carbon atoms, in which any substituent consists of a single hydroxy group, when used in preparing a cutting fluid according to the invention, is believed to react with the amine to form a salt that acts as a very effective wetting agent. The function of a wetting agent in an aqueous cutting fluid is to reduce the surface tension and increase the lubricity. (Water cannot be used alone as a cutting fluid, of course, because of its rusting properties, etc.). The unsaturated fatty acids used in the practice of the invention (in the form of amine salts) are effective lubricants which inhibit the corrosion of cast iron and steel. Furthermore, the amine salts of unsaturated fatty acids used in the practice of the invention are not irritating to the skin.

The fatty acids which may be used in the practice of the invention include the unsaturated acids derived from vegetable oils, such as oleic, linoleic, elaidic, linolenic, erucic and eleostearic acids. (A saturated fatty acid such as stearic acid is undesirable in the practice of the invention because its amine salts are solid pastes. Amine salts of saturated fatty acids such as coconut oil fatty acids (primarily lauric acid), on the other hand, not only are too thin liquids but also are irritating to the skin). Ricinoleic acid may be used in the practice of the invention, although the use of ricinoleic acid produces a cutting fluid that has less body and lower viscosity than a cutting fluid produced by the use of oleic acid. Triethanolamine is preferred in the practice of the invention not only for the reasons hereinbefore stated, but also because its salts with the unsubstituted higher unsaturated fatty acids that may be used in the practice of the invention, particularly with oleic acid, have outstanding wetting properties.

The triethanolamine salt of oleic acid imparts excellent extreme pressure lubricity to cutting fluids of the invention.

Another ingredient that may be used in the practice of the invention is a nonionic wetting agent. Nonionic wetting agents are distinguished from anion- and cation-active compounds by their superior stability toward saline solutions and salts of heavy metals and alkaline earth metals. Although these agents have the colloidal character of soap, they do not form salts. A nonionic wetting agent increases the emulsifying and softening powers of anion- and cation-active compounds. Thus, it is preferable to use a nonionic wetting agent in the practice of the invention to prevent the separation of the ingredients of a concentrated solution and to prevent the precipitation in hard water of a wetting agent such as triethanolamine oleate (e.g., as calcium oleate).

The classes of nonionic wetting agents which may be used in the practice of the invention include polymerization products of ethylene oxide; condensation products of fatty bodies or their derivatives (derivatives of fatty acids, fatty alcohols, fatty amides or fatty amines) with ethylene oxide; and products obtained by condensation of oxyalkylaryl compounds (derivatives of alkylphenols or alkyl-naphthols) with ethylene oxide. It is preferable that the nonionic wetting agents in these classes be of the soluble rather than the non-dispersible or dispersible type, since the soluble agents produce completely clear solutions and possess particularly effective softening and penetrating properties in aqueous solutions containing electrolytes and metallic salts. Such nonionic wetting agents include the polyethoxysters of fatty acids, the mono-oleate of polyethylene glycol, the mono-laurate of polyethylene glycol, the poly-ethoxyethers of fatty alcohols, the condensation product of an alkyl phenol such as dodecyl phenol with 12 moles of ethylene oxide, and the sulfonated product of the condensation of an alkylphenol or an alkyl-naphthol with ethylene oxide. A particularly efficient nonionic wetting agent is an alkylated aryl polyether alcohol.

ANTIFOAM AGENTS.

The use of a foam inhibitor in the practice of the invention, by preventing cutting fluids of the invention from foaming, increases their efficiency and also helps to keep the fluids clear during a cutting operation so as to make it easier to see the work.

For example, any known antifoam agent which has a surface tension lower than that of the cutting fluid, which has a low solubility in the cutting fluid and which is readily dispersible in the cutting fluid may be employed. Such substances include silicon

compounds, ethyl oleyl glycol *o*-phosphate, triocyl tripolyglycol tetrapolyphosphate, glyceryl monoricinoleate, 2-amino-2-methyl-1-propanol, tetraocyl pyrophosphate, mono-oleyl dipolyglycol *o*-phosphate, diethylene glycol monooleate, diglycol dinaphthenate, ethyl phosphate, polyoxyalkylene sorbitan monooleate, *n*-nonyl alcohol, *n*-butyl phthalate and substantially completely fluorinated hydrocarbons having from 5 to 10 carbon atoms. Of these substances, the silicon compounds, particularly silicones, are by far the most effective.

The most desirable of the silicone and silicate antifoam agents are those of higher molecular weight, for example those in which each saturated hydrocarbon group is a straight, branched or closed chain group having from 14 to 24 carbon atoms, the total number of carbon atoms being at least 24. The hydrocarbon groups may be substituted with alkoxy, nitro, halogen, or esterified sulfonic groups which do not interfere with the foam-reducing properties of the silicon compounds. The hydrocarbon groups may be, for example, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl and tetracosyl.

The silicones may be prepared by hydrolyzing the corresponding organosilicon halide, such as the chloride, bromide or iodide (preferably the chloride) by any of the well-known procedures for hydrolyzing halosilanes and then partially or completely condensing the resulting silanols.

The silicates may be prepared by reacting the desired alcohol, selenol, mercaptan or tellurol (or mixtures thereof) with silicon tetrachloride and water to obtain the meta silicate, or with tetraethyl orthosilicate to obtain the orthosilicate by ester exchange reaction.

The silicone antifoam agents may be used in conjunction with other foam-reducing agents, e.g., sulfonated fish oils or high molecular weight saturated fatty acids.

The cutting fluids of the invention may be prepared in the form of thixotropic gels by the incorporation of a solvent of the class consisting of alcohols having more than three carbon atoms and ethers of such alcohols. The presence of such a solvent is desirable because it helps to prevent the ingredients of the present cutting fluids from separating out. In fact, if a silicone antifoam agent is present in a cutting fluid of the invention, it is essential that such a gel-forming solvent be present in order to prevent the silicone from separating. Furthermore, a gel-forming solvent such as pine oil coacts with the silicone in a synergistic manner to give enhanced antifoam properties.

Although any alcohol having more than

three carbon atoms such as butyl, amyl, hexyl, heptyl, octyl or nonyl alcohol may be used as a gel-forming solvent, a higher cyclic alcohol such as a cyclic terpene alcohol is preferred for its pleasant, anti-septic odor. An ether of an alcohol having more than three carbon atoms, such as safrole, also may be used.

Pine oil, whose chief constituent is a terpineol, and sassafras oil, which consists mainly of safrole, are excellent gel-forming solvents for use in the practice of the invention. These substances not only lack offensive odor but also are free of skin-irritating properties. Furthermore, they even act as mild germicides and possess foam inhibiting properties of their own.

Terpinyl ethylene glycol ether is a particularly advantageous gel-forming solvent. It has substantially all of the advantages of pine oil and sassafras oil, and has the further advantage that it has only a very mild odor. This substance is probably the most useful gel-forming solvent in the practice of the present invention because it can be incorporated in the desired quantities without imparting a strong odor to the composition.

Another ingredient that is advantageous in a cutting fluid of the invention is a substance such as an alkali metal borate or an alkali metal nitrite, which acts both as a rust inhibitor and as an aid in the formation of a thixotropic gel with a gel-forming solvent such as pine oil. Among these substances, the potassium compounds such as potassium tetra borate and potassium nitrite are preferred. Potassium tetra borate is a particularly good corrosion inhibitor and has bactericidal properties. Potassium nitrite on the other hand gives cutting fluids that tend to form a liquid residue upon drying rather than a paste or gum. The formation of a liquid residue upon drying greatly facilitates the use of the cutting fluid.

Although many of the ingredients of the cutting fluid of the invention have bactericidal properties, in some cases it is desirable to incorporate additional agents to inhibit the growth of bacteria and fungi around the moist parts of a machine, and to prevent the attack of bacteria upon sulfur compounds such as those present in iron or steel.

PREPARATION OF CUTTING FLUID.

In the preparation of an aqueous cutting fluid of the invention, the ingredients may be mixed in any desired order, so long as the final product is a water-miscible, water-clear fluid. Preferably, the boric acid (desirably in finely divided form to facilitate solution) is mixed with water and the amine, and the mixture is stirred at room temperature until the boric acid is dissolved. Although molar equivalents of the amine and the boric acid may be used, it is preferable to employ

an excess of the amine (e.g., a 1 to 100 per cent excess, and preferably a 3 to 10 per cent excess). (The terms "per cent" and "parts" are used herein to mean per cent and parts by weight unless otherwise specified). The proportion of water in the solution at this point should be sufficient to form a clear liquid, i.e., 5 to 40 mols per mol of the boric acid.

When an unsaturated fatty acid is used as hereinbefore described, a salt of the unsaturated fatty acid with the amine may be added to the solution of the boric acid and the amine at room temperature. Alternatively, the unsaturated fatty acid itself may be added slowly to a solution comprising the boric acid and an amount of the amine which is in addition to the amount of the amine described in the preceding paragraph, such additional amount of the amine being the molar equivalent of the amount of fatty acid used, and the mixture may be allowed to stand until the amine salt of the fatty acid is formed. (Usually about three hours at room temperature is sufficient for the reaction to take place). This procedure is ordinarily desirable, particularly when the same amine salt of both the boric acid and the unsaturated fatty acid is used in the cutting fluid. (As hereinbefore stated, triethanolamine salts of boric acid and oleic acid are particularly advantageous). As soon as such wetting agent is incorporated, it is desirable to add a nonionic agent (as hereinbefore described) in order to stabilize the solution (i.e., to prevent precipitation of the former wetting agent) and to keep the solution clear.

It is preferable to employ 40 grams of the nonionic wetting agent per mol of the fatty acid salt although the proportions depend, upon the hardness of the water, the effectiveness of the nonionic wetting agent.

A gel-forming solvent (for example, pine oil) and an antifoam agent may then be added to form a thixotropic gel. The proportion of gel-forming solvent may range from 20 to 60 grams per mol of the boric acid, but preferably is from 30 to 50 grams per mole of the boric acid. The proportion of antifoam agent depends, of course, upon the effectiveness of the agent and upon the degree of foaming of the cutting fluid, but in general may range from 1.0 to 7.0 grams per mol of the boric acid, and preferably is 2.0 grams per mole of the boric acid.

Before adding an antifoam agent, it is desirable to dissolve additives such as sodium nitrite and germicides in water and then to add this solution slowly to the cutting fluid. In general, it is preferable to use from 20 to 40 grams of an alkali metal nitrite (a proportion in the lower part of the range is effective with a higher proportion of gel-forming solvent) or from 20 to

90 grams of an alkali metal tetra borate per mol of the boric acid.

The extent of water dilution of the "concentrate" prepared as described above depends upon the particular cutting operation in which the fluid is to be employed. In general the cutting fluids of the invention are effective when such a concentrate is diluted with as much as 100 times its weight of water, although the preferred cutting fluids are prepared by diluting such a concentrate with 20 to 50 times its weight of water. If desired, the concentrate may be diluted with only 5 to 10 times its weight of water.

EXAMPLE 1.

A mixture of boric acid (30 parts), triethanolamine (75 parts), sodium mercaptobenzothiazole (2.2 parts) and water (107 parts) is stirred at room temperature until a clear solution is formed. (The amount of sodium mercaptobenzothiazole may be as low as .1 part or as high as 5 parts). The resulting "concentrate" may be diluted with 20 to 100 times its weight of water to produce a cutting fluid having a pH of 8.5.

EXAMPLE 2.

(a) A cutting fluid of the invention is prepared by the following procedure:—
A mixture of boric acid (30.68 parts), triethanolamine (132.48 parts) and water (349 parts) is stirred at room temperature until the boric acid is dissolved. Oleic acid (66.84 parts) is then added slowly to the mixture over a period of one hour. The resulting mixture is allowed to react at room temperature for three hours before 10 parts of a nonionic wetting agent known under the Registered Trade Mark "Triton X-100", an anhydrous octylphenol polyether alcohol is added as a stabilizer to keep the solution clear.

In a separate vessel there is mixed at room temperature water (50 parts), sodium nitrite (20 parts), and 13.2 parts of a germicide known under the Registered Trade Mark "Vancide No. 51", which is an aqueous solution containing 1.5 per cent of the sodium salt of mercaptobenzothiazole and 28.5 per cent of the sodium salt of di-thiocarbamic acid. When a solution is obtained, it is added slowly over a period of two hours to the solution prepared as described in the preceding paragraph, the temperature being not higher than 25 degrees C. during the addition. To the resulting mixture there is added at room temperature a mixture of 10 parts of pine oil and 1.35 parts of a silicone antifoam agent (GE 81066 or GE 81224).

(b) A cutting fluid is prepared by the procedure described in (a) except that the proportion of pine oil is 20 parts and the

proportion of sodium nitrite is 10 parts.

The concentrate prepared as described in (a) above is tested for load-carrying properties by the standard Falex seizure test employing steel V-blocks and steel pins. After a three minute break-in period at 300 pounds jaw load, the load is increased in increments of 100 pounds with one minute running time, until failure occurs. The load failure is a measure of the load-carrying properties of the composition under test. The Falex load at failure of an aqueous solution comprising 2 per cent of the concentrate prepared as described in (a) is 4300 pounds; comprising 4 per cent of the concentrate, 4500 pounds (the maximum load of which the machine is capable).

The surface tension (measured by a DuNuoy Tensionmeter) of an aqueous solution comprising 20 per cent of the concentrate prepared as described in (a) above is 26.1 dynes; comprising 11.1 per cent of the concentrate, 26.4 dynes; 7.7 per cent of the concentrate, 26.7 dynes; and 5.9 per cent of the concentrate, 27.0 dynes. In contrast, a heavy duty soluble oil which comprises 3.17 per cent sulfur and 0.7 per cent chlorine has a surface tension of 35.7 dynes in an 11.1 per cent solution; 37.3 dynes in a 7.7 per cent solution; and 38.2 dynes in a 5.9 per cent solution. The surface tension of water is 72 dynes at room temperature. Thus, a cutting fluid of the invention wets much better than water or a soluble oil emulsion. (Good wetting is not obtained until a surface tension below 30 dynes is reached).

EXAMPLE 3.

A cutting fluid of the invention is prepared by a procedure that is the same as in Example 2 (a) except that the amount of water in the first addition is 369 parts; the amount of water in the second addition is 40 parts; potassium nitrile (15 parts) is used instead of sodium nitrite; the amount of the silicone antifoam agent used is 1.0 part; the amount of pine oil is 6.6 parts; and terpinyl ethylene glycol ether (17.5 parts) and sassafras oil (2.2 parts) are added along with the pine oil. The resulting concentrate is superior to those prepared in accordance with Example 2 in that it produces cutting fluids which have a less pronounced odor and which, upon drying, leave a fluid residue rather than a solid residue.

EXAMPLE 4.

A concentrate prepared as in Example 1 is mixed with from $\frac{1}{3}$ to twice its weight of a concentrate prepared as in Example 2 (a). The resulting concentrate makes a good general purpose cutting fluid for grinding and machining when diluted with 20 to 40 times its weight of water. The lubricat-

ing effect increases as the proportion of the concentrate prepared as in Example 2 (a) increases.

EXAMPLE 5.

5 A mixture of boric acid (28 parts), triethanolamine (180 parts) and water (337 parts) is stirred at room temperature until the boric acid has dissolved. Erucic acid (61.2 parts) is then added slowly to the mixture over a period of one hour. After the resulting mixture has been allowed to react at room temperature for three hours, 9 parts of a nonionic wetting agent known under the Registered Trade Mark "Triton X-100" is added.

15 In a separate vessel there is mixed at room temperature water (37 parts), potassium nitrite (14 parts) and 12 parts of a germicide known under the Registered Trade Mark "Vancide No. 51". When a solution is obtained, it is added slowly over a period of two hours to the solution prepared as described in the preceding paragraph, the temperature being not higher than 25 degrees C. during the addition. To the resulting mixture there is added at room temperature a mixture of approximately 3 parts of ocotea cymbarum (an ingredient of sassafras oil), 11 parts of alpha-terpineol, 11 parts of terpinyl ethylene glycol ether and 0.9 part of a silicone antifoam agent (GE 81066 or GE 81224).

25 The concentrate so prepared has properties similar to those of the concentrate prepared in accordance with Example 2 (a). It may be diluted with 5 to 100 times its weight of water to produce a cutting fluid which is found to have excellent stability and to inhibit corrosion of common metals. 30 The crude mixture of fatty acids derived from rapeseed oil can be used in place of erucic acid, the resulting concentrate being slightly darker in color.

EXAMPLE 6.

45 A concentrate is prepared by the same procedure used in Example 5 except that the ingredients used are: boric acid (30.4 parts), triethanolamine (130.5 parts), water (349 parts), castor oil fatty acids, consisting of approximately 80 per cent by weight of ricinoleic acid (69.13 parts), "Triton X-100" (Registered Trade Mark) (10 parts); a solution in 56 parts of water of sodium nitrite (20 parts) and "Vancide No. 51" (Registered Trade Mark) (13.2 parts); and pine oil (9.6 parts). The resulting concentrate, which is a liquid, can be used to give results very similar to those obtained with the concentrates prepared in accordance with Examples 2 (a) and 5, which are gels, with the exception that the concentrates which are gels are more suitable for the incorporation of a silicone foam inhibitor, and have less tendency to foam because they include such a foam inhibitor.

65 The concentrate prepared in accordance with the present example may be diluted with 5 to 100 times its weight of water to produce cutting fluids, and the cutting fluids so prepared have been found to be stable and to inhibit corrosion of common metals.

WHAT WE CLAIM IS:—

1. A stable aqueous cutting fluid comprising a salt of boric acid and an aliphatic amine, having from 1 to 3 aliphatic radicals each of which contain from 1 to 4 carbon atoms, and having at least one hydroxy group attached to a carbon atom, the amount of free and combined amine in the composition being at least the molar equivalent of the boric acid and being not more than 100 per cent in excess of the molar equivalent of the boric acid, and the composition also containing an amount of water equal to 5 to 40 mols per mole of boric acid.

2. A stable aqueous cutting fluid as claimed in Claim 1 wherein the amine is triethanolamine.

3. A stable aqueous cutting fluid as claimed in Claim 1 which also contains a reaction product of an unsaturated fatty acid having from 18 to 22 carbon atoms in which any substituent consists of a single hydroxy group, and an aliphatic amine, having from 1 to 3 aliphatic radicals each of which contains from 1 to 4 carbon atoms, and having at least one hydroxy group attached to a carbon atom, the number of mols of combined fatty acid in the composition being from $\frac{1}{5}$ to $\frac{2}{5}$ the number of mols of combined boric acid, the number free and combined mols of such amine being at least as great as the sum of the number of mols of combined boric acid and the number of mols of combined fatty acid, and being not more than the sum of the number of mols of combined fatty acid plus twice the number of mols of combined boric acid.

4. A stable aqueous cutting fluid as claimed in Claim 3 wherein the fatty acid is an unsubstituted unsaturated fatty acid having 18 carbon atoms.

5. A stable aqueous cutting fluid as claimed in Claim 4 wherein the number of combined mols of the fatty acid is from $\frac{1}{5}$ to $\frac{2}{5}$ the number of combined mols of boric acid.

6. A stable aqueous cutting fluid as claimed in Claim 5 which also contains a gel-forming solvent of the class consisting of alcohols having more than three carbon atoms and ethers of such alcohols, the amount of such solvent being from 20 to 60 grams per mol of boric acid in the composition, measured as free boric acid.

7. A stable aqueous cutting fluid as

claimed in Claim 6 which also contains from 1 to 7 grams of a silicone antifoam agent per mol of boric acid in the composition, measured as free boric acid.

- 5 8. A stable aqueous cutting fluid as claimed in Claim 7 which also contains from 20 to 90 grams of potassium tetra borate per mole of boric acid in the composition, measured as free boric acid.

9. A stable aqueous cutting fluid sub- 10
stantially as herein described.

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